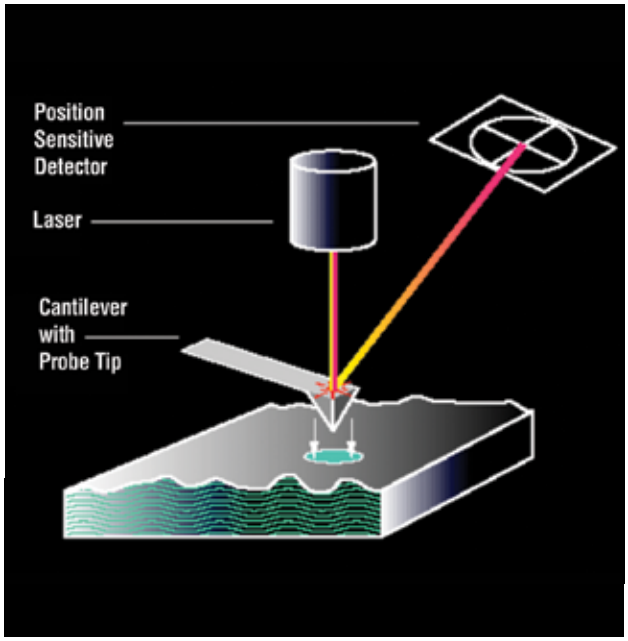
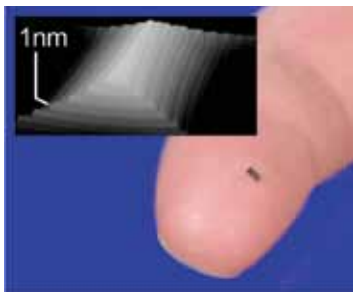
National Aeronautics and Space Administration

technology opportunity

Method for Production of Nanometer Scale Step Height Reference Specimens

This reference method can provide step height standards below 1 nanometer and is suitable for use with scanning probe microscopes





NASA's Glenn Research Center is offering an innovative technique for fabricating defect-free nanometer-scale steps on single-crystal substrates such as silicon carbide (SiC). These nanometer-scale steps enable step height calibration suitable for scanning probe microscopes and profilometers. As there is no generally available and reliable calibration standard covering the range from 10 nm to below 1 nm, this technology fills that need for semiconductor fabrication and testing and other applications requiring precise surface profile measurements.

Benefits

- **Precise:** Provides a method to produce SiC substrates for step height calibration down to 1 nanometer with only atomic scale local roughness
- **Robust:** Uses a SiC surface that is harder and more inert than the silicon used in previous standards
- **Versatile:** Removes the need for electrically conductive coating, enabling use in scanning probe microscopes or electron beam-based instruments
- **Cost Effective:** Eliminates the need to send sample standards to the National Institute of Standards and Technology (NIST) for certification since the step height is fixed
- **Defect Free:** Employs growth and etching processes to create special mesas that discourage and prevent the formation and propagation of defects that may cause unwanted steps

Applications

- **Scanning probe microscopes**
- **Profilometers**
- **Scanning tunneling microscopes**
- **Atomic resolution imaging**

Technology Details

How It Works

Glenn's patented process creates nanometer-scale steps on SiC substrates using growth and etching processes that prevent defects. Patterned arrays of mesas (planar surfaces) are etched into a selected crystal plane. Nanometer-scale steps are produced on top of the mesa surfaces through growth and etching processes. This structure can then provide step height calibration from less than 1 nanometer to greater than 10 nanometers with no more than atomic scale local roughness.

Why It Is Better

The ability to have a step height calibration device for measurement at multiple nanometers down to 1 nanometer and below was not available previously because commercially available single-crystal SiC substrates used to create steps contain defects that impact their quality, reproducibility, and utility. The defects, for instance, could be large enough to create a "false" step or could alter the height of an intended step. Also, these random defects made steps and step height standards that could not be reliably reproduced. Since the step height standard is fixed, users don't need to send sample standards to NIST for certification – a significant cost savings. This method, which has been honored with an R&D 100 award, should improve the cost-effectiveness of using nanoscale structures.

Patents

Glenn holds U.S. Patent No. 6869480 on the technology.

Licensing and Partnering Opportunities

Glenn's Technology Transfer and Partnership Office seeks to transfer technology into and out of NASA to benefit the space program and US industry. NASA invites companies to consider licensing the Step Height Reference (LEW-17157-1) for commercial applications.

For More Information
For more information about this and other technology licensing opportunities, please visit:

Technology Transfer and Partnership Office
NASA's Glenn Research Center
E-mail: ttp@grc.nasa.gov
Phone: 216-433-3484
http://technology.grc.nasa.gov/